

# Quality Assurance Validation and Verification Modeling

Rapid Tooling and Manufacturing '97  
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# Agenda

- Changing Role of Quality Assurance
  - Demands
  - Solutions
- Accomplishments to Date
- The Future of RP at JPL

# New Demands on the Role of QA

- Everything JPL builds is a Prototype of One Form or Another
- Project Development Schedules Have Been Compressed to 18 mos
- Quality Assurance Must Offer Solutions to *meet* the Demands of our Changing Environment

# Innovative Solutions

- Inject The QA Function into Hardware Concept Development. Building Quality into the Design Rather Than Assess it After the Fact
- Use Rapid Prototype Models During the Manufacturing/Test/Verification Phases of a Projects Development
  - Aid to Machinist/Assemblers/Test Engineers
  - First Article & Final Inspection

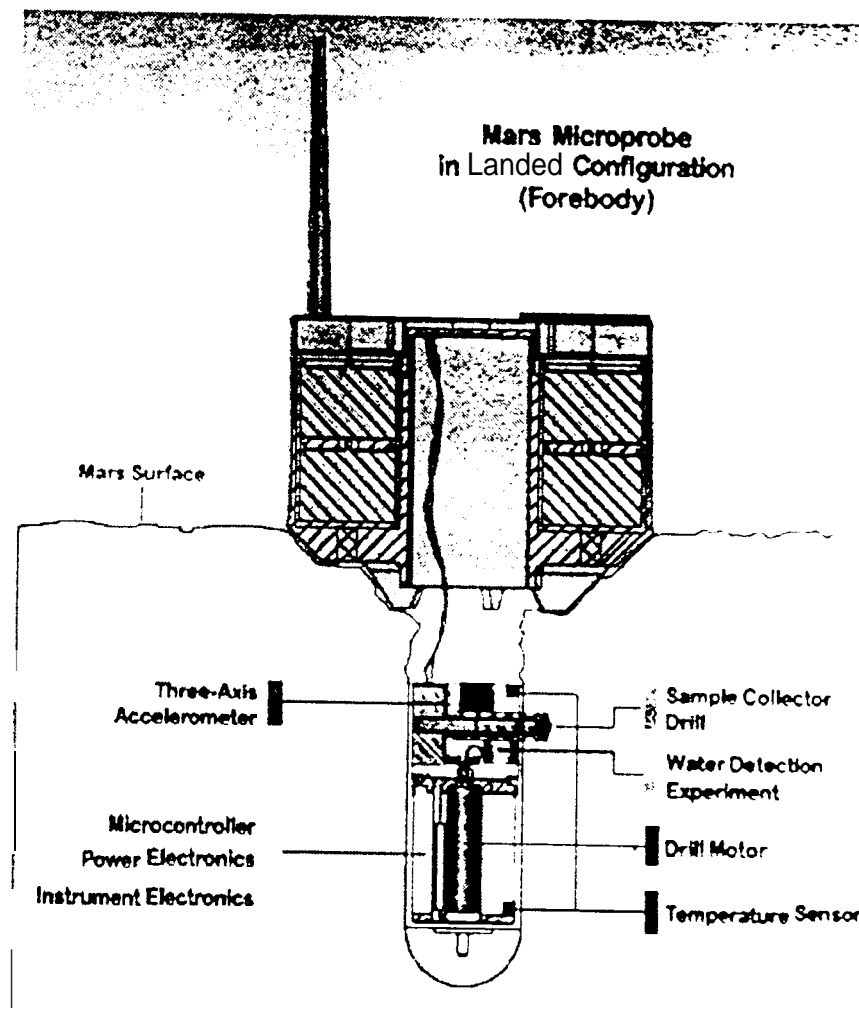
# Byproducts

- Asteroid Modeling Used To Define Asteroids Axis of Rotation & Geological Data
- Martian Surface modeling Used to Guide the Rover & Avoid Pitfalls

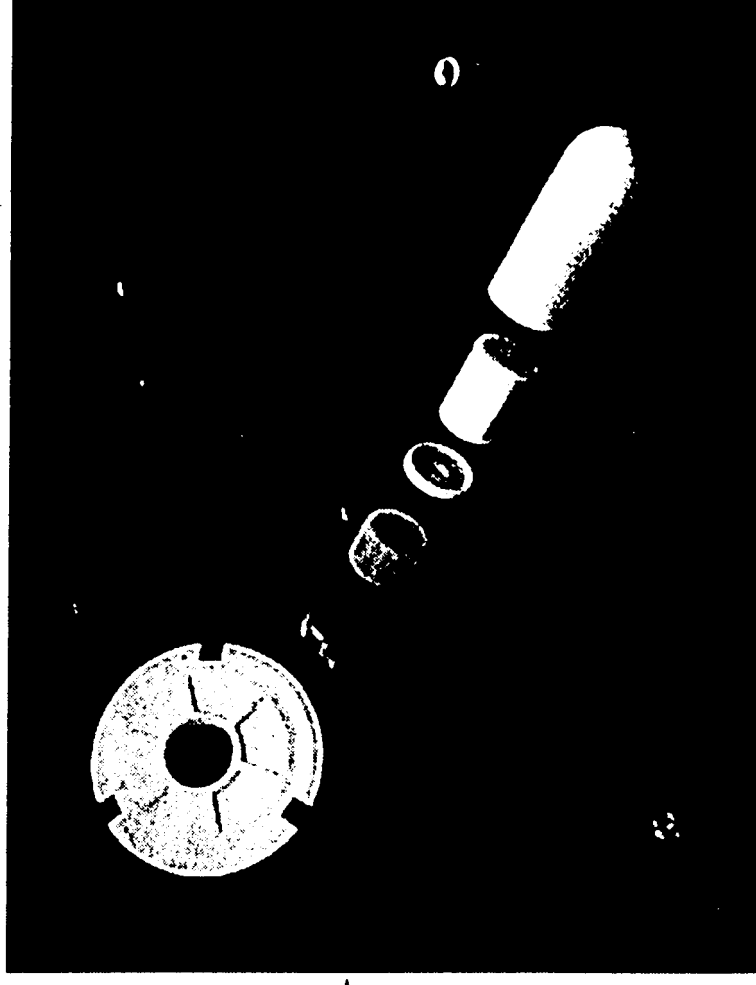
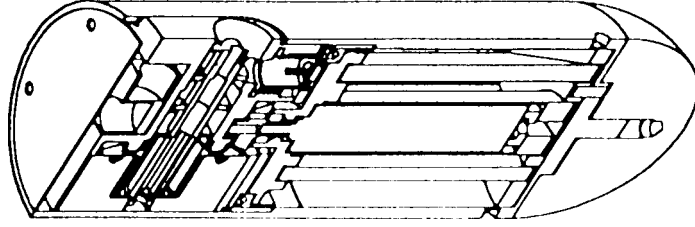
# Facilities

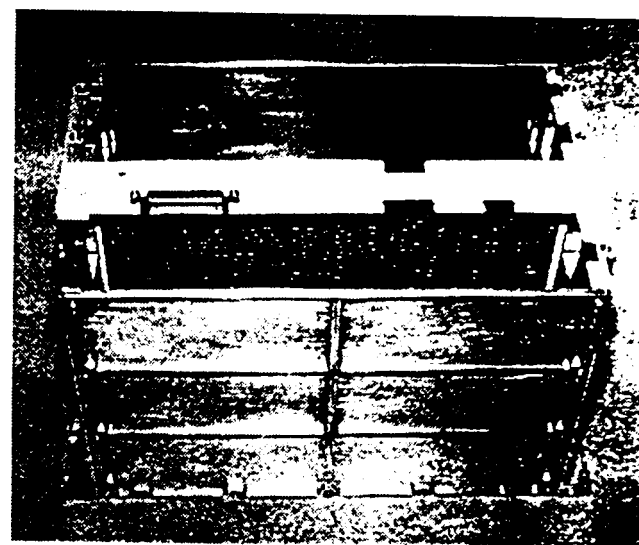
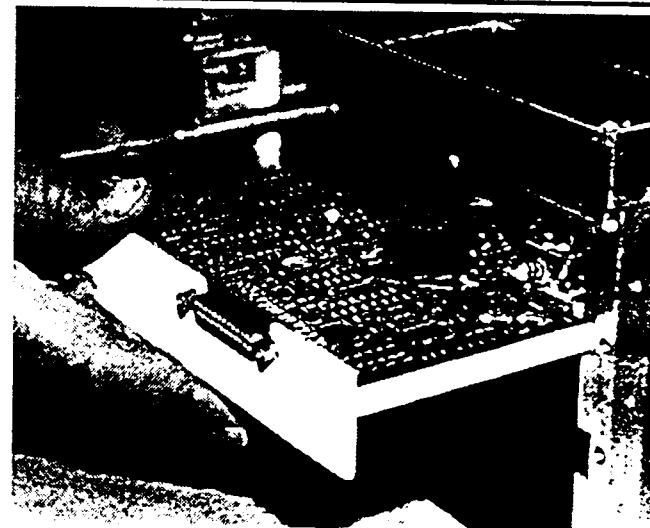
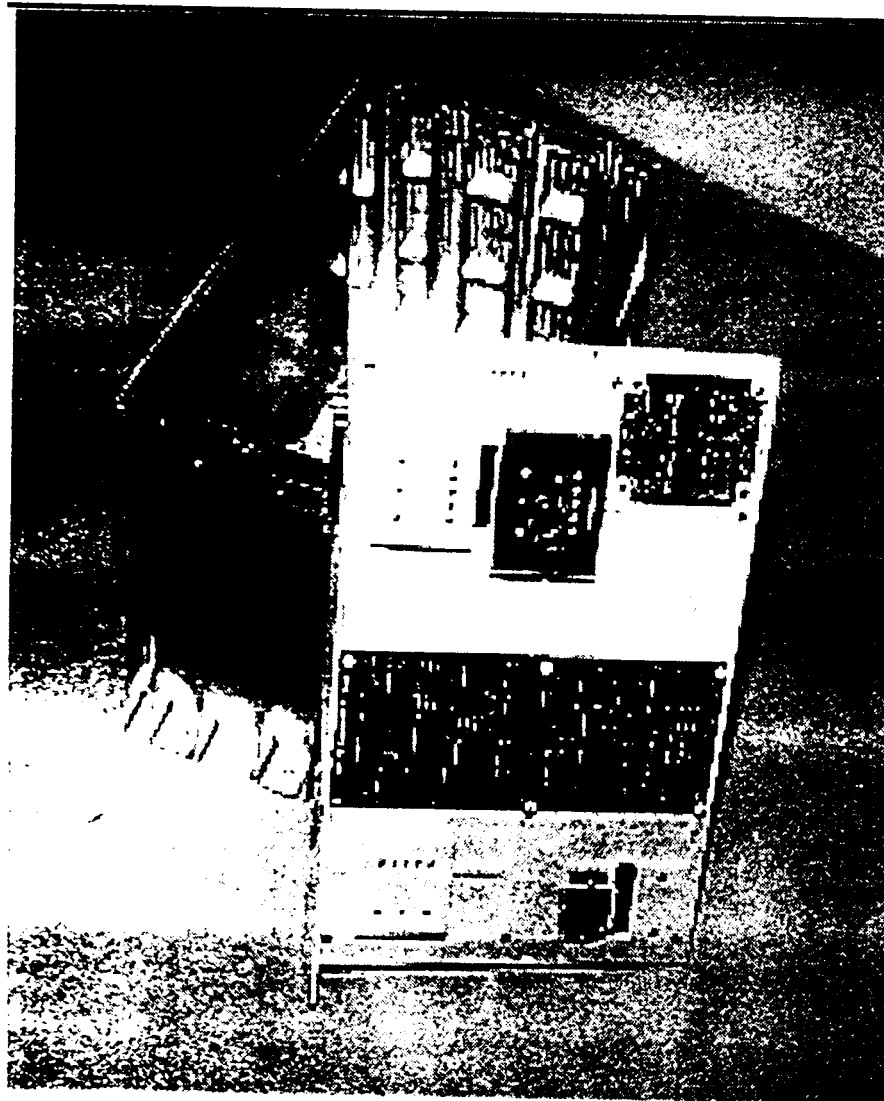
- 1 Dedicated Building with Two RP Workcells Operating Nearly 24 Hours a Day
  - DTM Sinterstation 2500
  - 3D Systems Actua Concept Modeler

# Accomplishments to Date

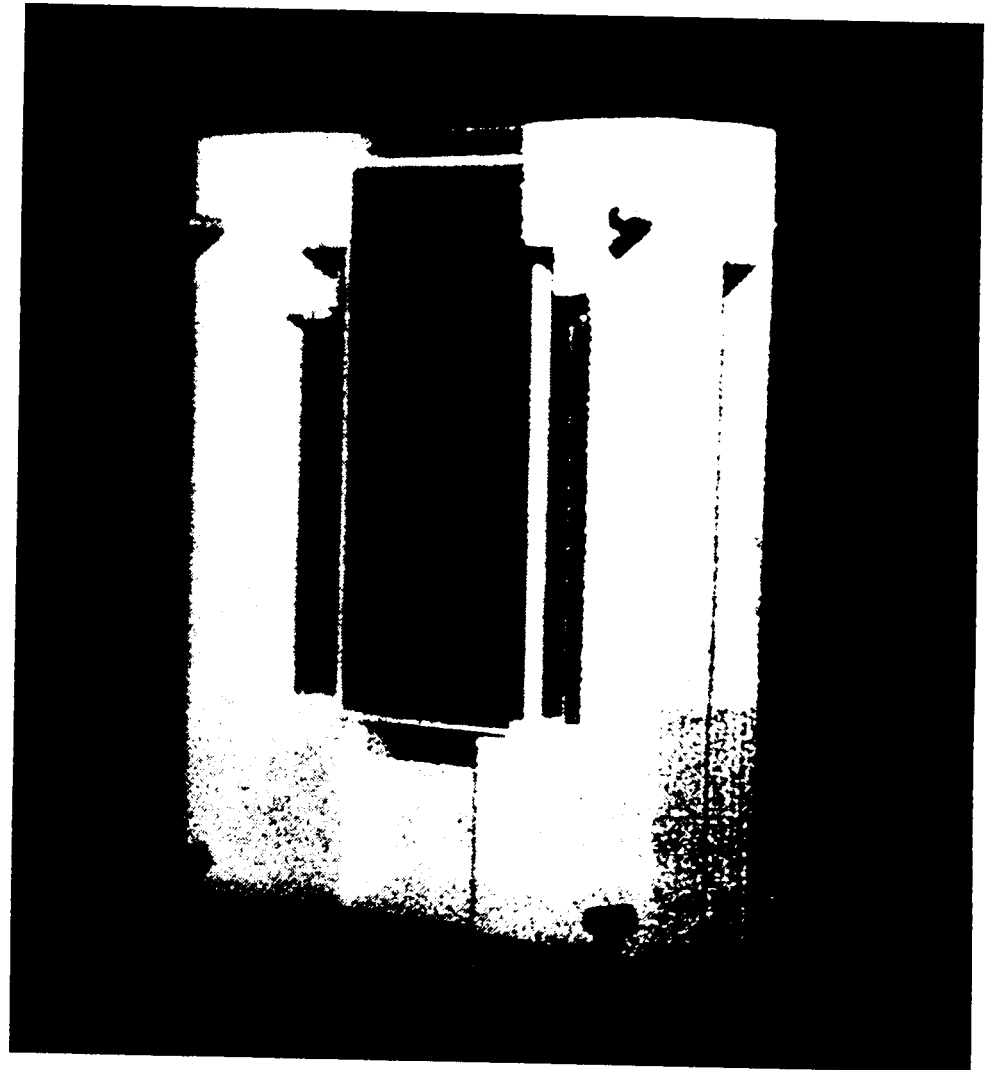


- One day turn-around to create these models for the DS 2 projec



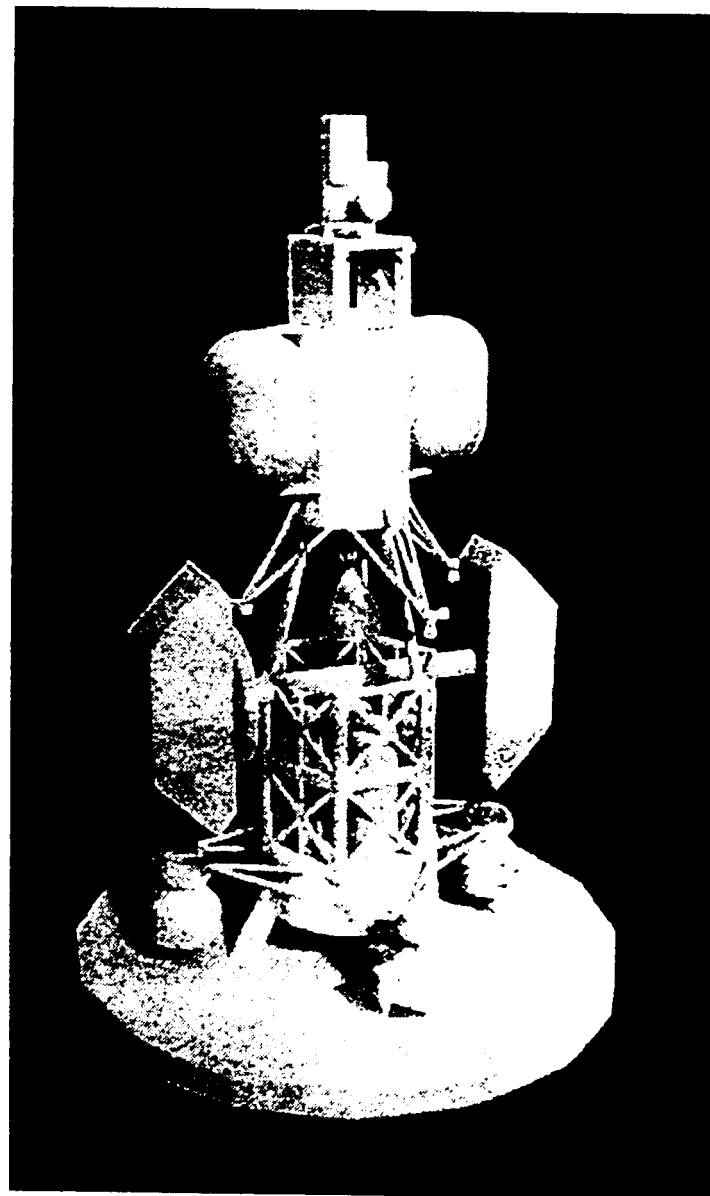


- DS 2 required alignment tooling that could be used at two different suppliers and JPL
- A RP model of the tooling was designed and completed within one day
- This alignment tooling is now being used by the DS 2 project

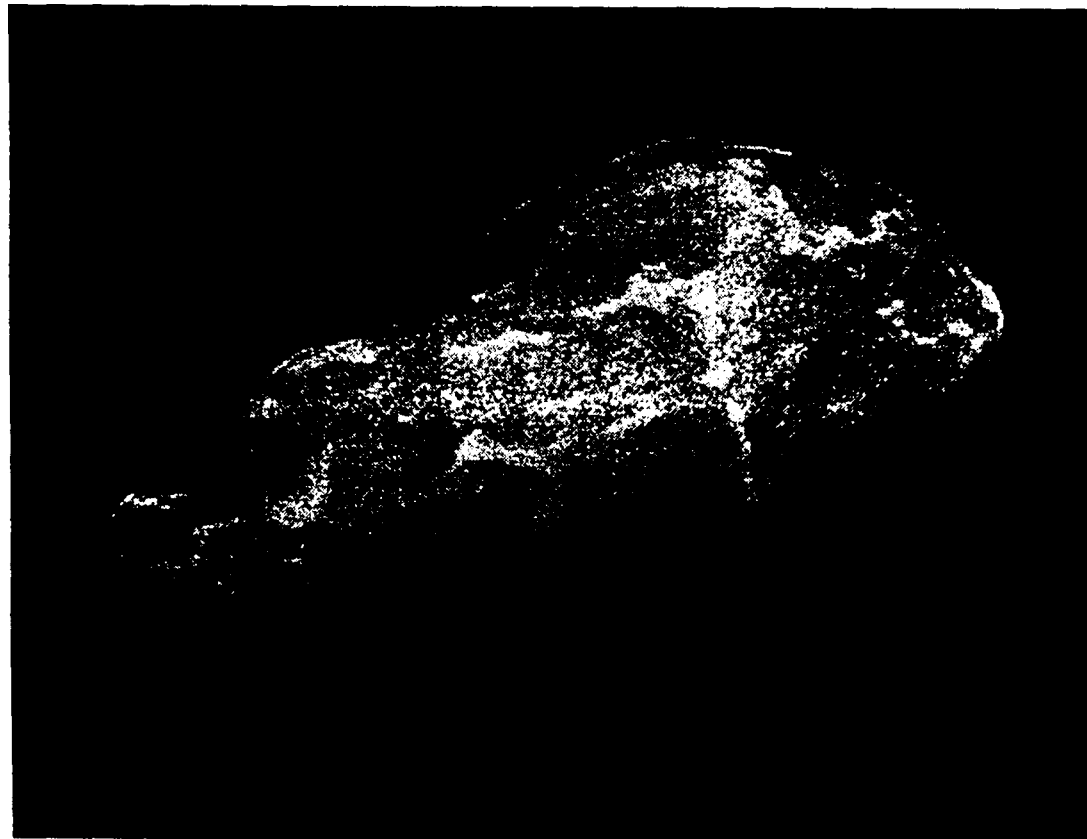


- Team X's goal is to allow users of the Team X concept development activities to have a mission concept completed in one week and have a system level model the following week
- We have linked our RP workcells to the Team X activities to provide this support

Conceptual Model: Europa Spacecraft  
sitting upon a multi-mission  
propulsion and power systems



- “Prior to Rapid Prototyping, the ability to make precision 3-D models of asteroids did not exist,” Dr. Steve Ostro - JPL Scientist
- Steve Ostro and his colleagues are using the RP models to help . define asteroid axis of rotation and geologic data



Picture of the 3-D  
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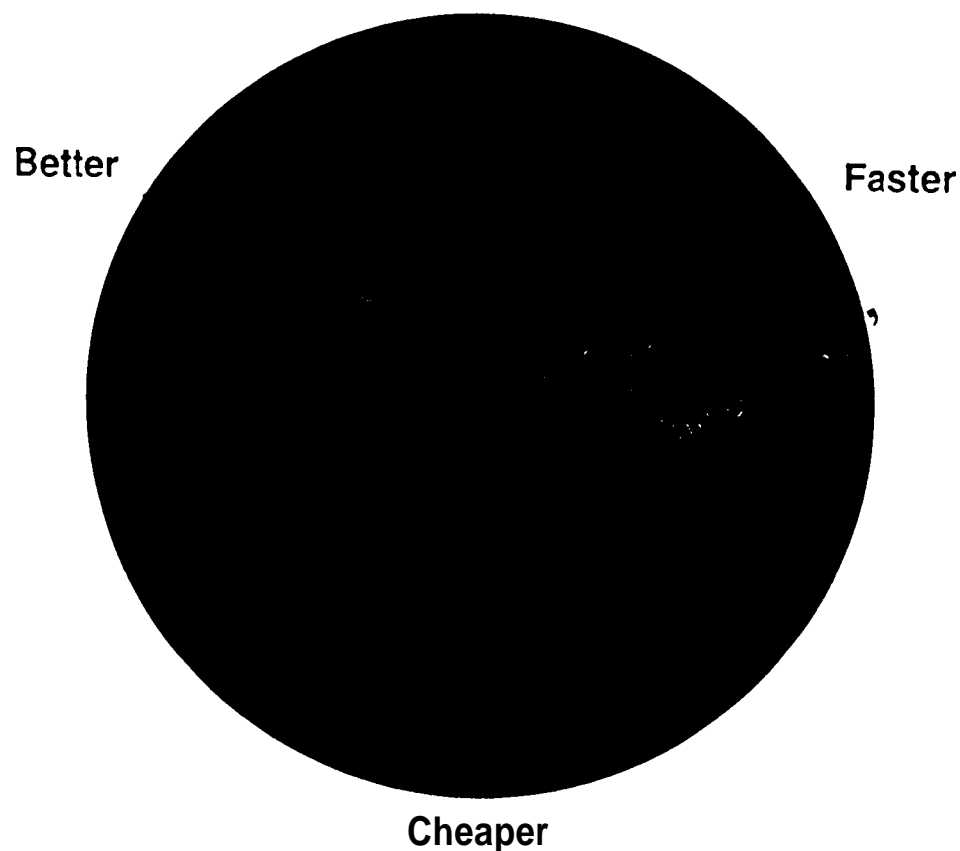
# The Future of RP at JPL

- Continue to Find innovative ways to improve the Manufacture Processes at JPL Using RP
- Develop a JPL-Led consortium to research and Develop Direct Metal Fabrication Using The SLS and Aluminum Alloy Powders
- Support Projects with the Use of RP Models to Optimize Their Budget and Schedule Constraints

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•RP offers solutions to the three primary dimensions which NASA projects are positioning themselves on

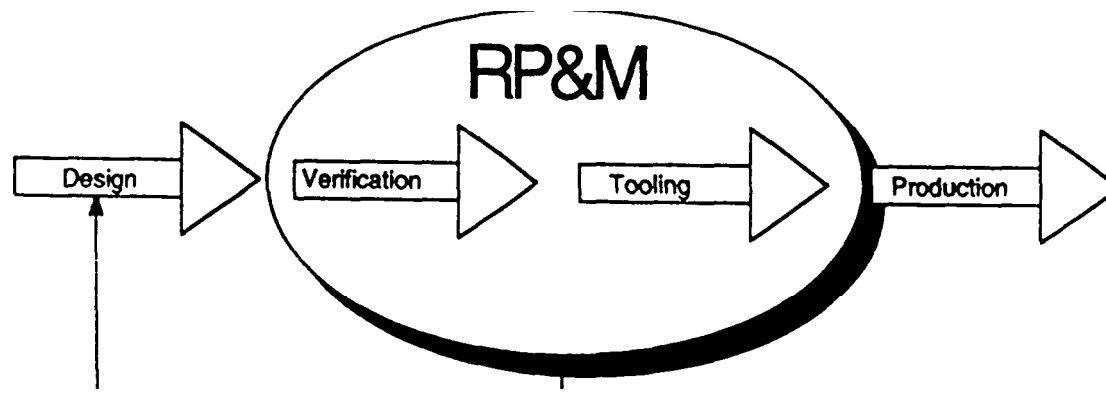
– Its rare to find **a** single tool that can strongly support all three dimensions



*First draft—*

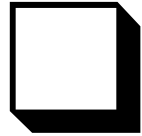
- **JPL RP Task Objectives**
- **Application Examples of RP Models**

- **OEMA'S interest are focused on assessing the application of Product Assurance (PA) processes on RP models**
  - In addition, OEMA is sponsoring the use of the RP models for many other activities related to JPL's strategic goals
- **Objective has been to use the RP models as a Concurrent Engineering tool and push the Quality Engineering activities closer to hardware concept development**

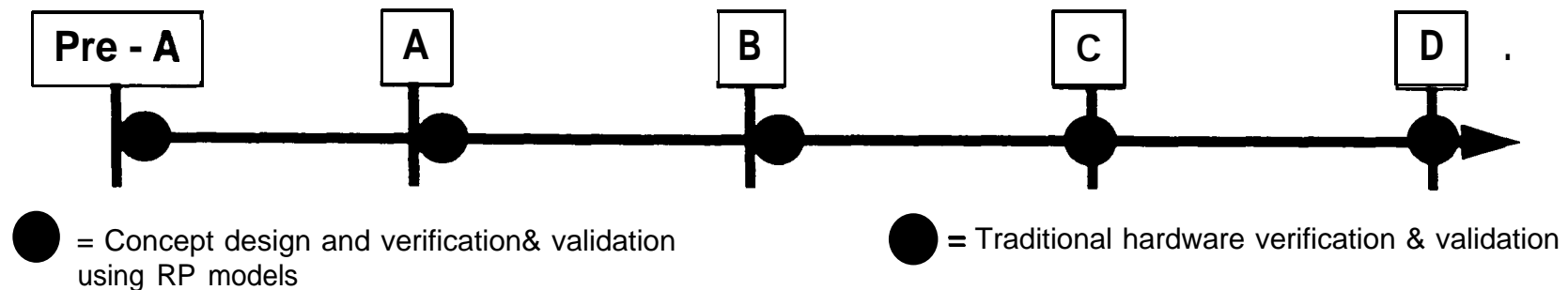


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- **With 18 mos. centered development activities, traditional design, prototyping, validation, assembly and testing need to be compressed**
    - Assurance activities need to support these activities with innovative ways of identifying quality problems early in the design
    - RP provides a vehicle to perform assurance activities very early in the development cycle
  - **Isometric drawings don't give all the details for meaningful design assessments/verifications**
  - **“ Interfaces between parts delivered from different sources can be checked far in advance of delivery**
  - **More robust/reliable designs, earlier in the development life-cycle**

# JPL RP Helps Fast-Paced Projects Assure Mission Success



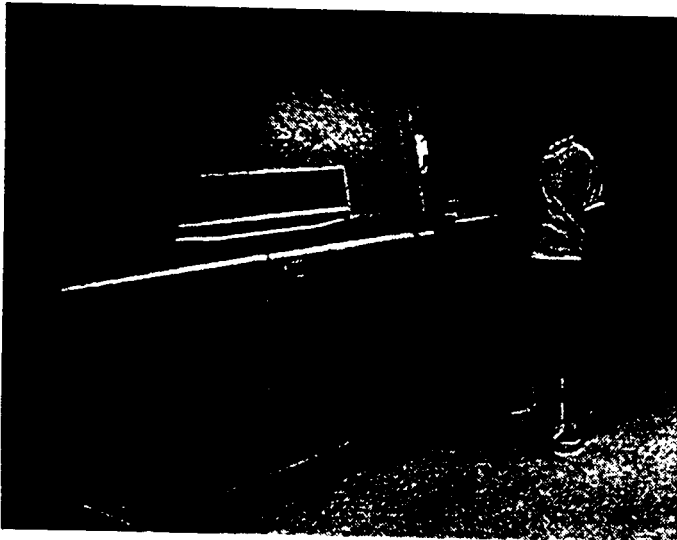
Project Phase:



- **Pre-Phase A - Advanced Studies:** Models support the concept design and evaluation
- **Phase A - Preliminary Analysis:** RP models used to support development of functional mission concept and trade & analysis
- **Phase B - System Definition/Preliminary Design:** RP Models Support Risk Assessment, Design to specs, verification plans, ICDs, etc.

- Code Q has sponsored the acquisition of the Selective Laser Sintering (SLS) and Concept Modeler Rapid Prototyping workcells and the research for applying Product Assurance processes to these models
- JPL has dedicated facilities for the RP workcells and access to these workcells is available to all JPL projects and research activities

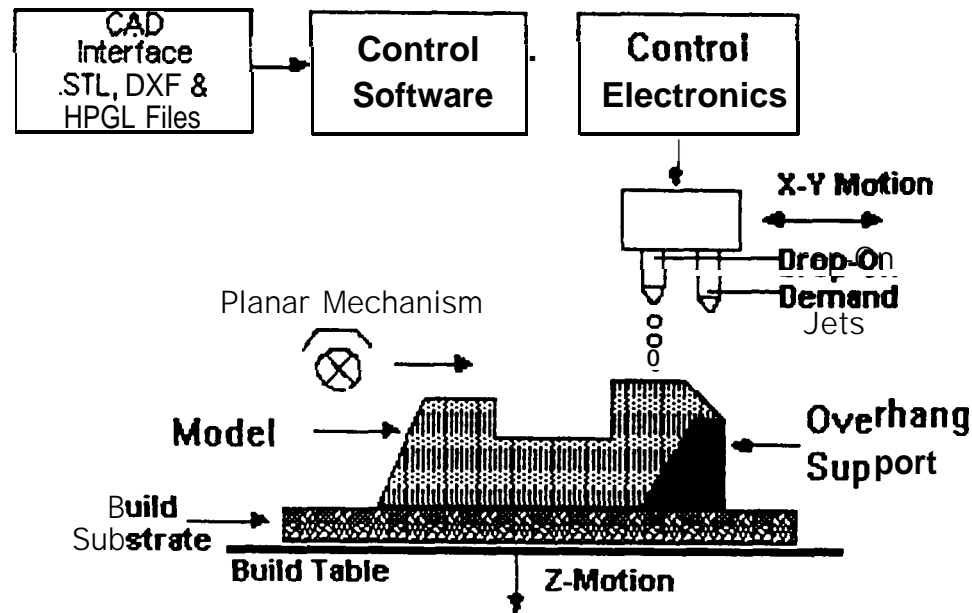
SLS Workcell



Concept Modeler Workcell



- Uses ink-jet technology to produce 3-D models
- Most affordable of the 3-D modeling technologies
- Used very early in the design process and affords multiple model builds as the concept matures

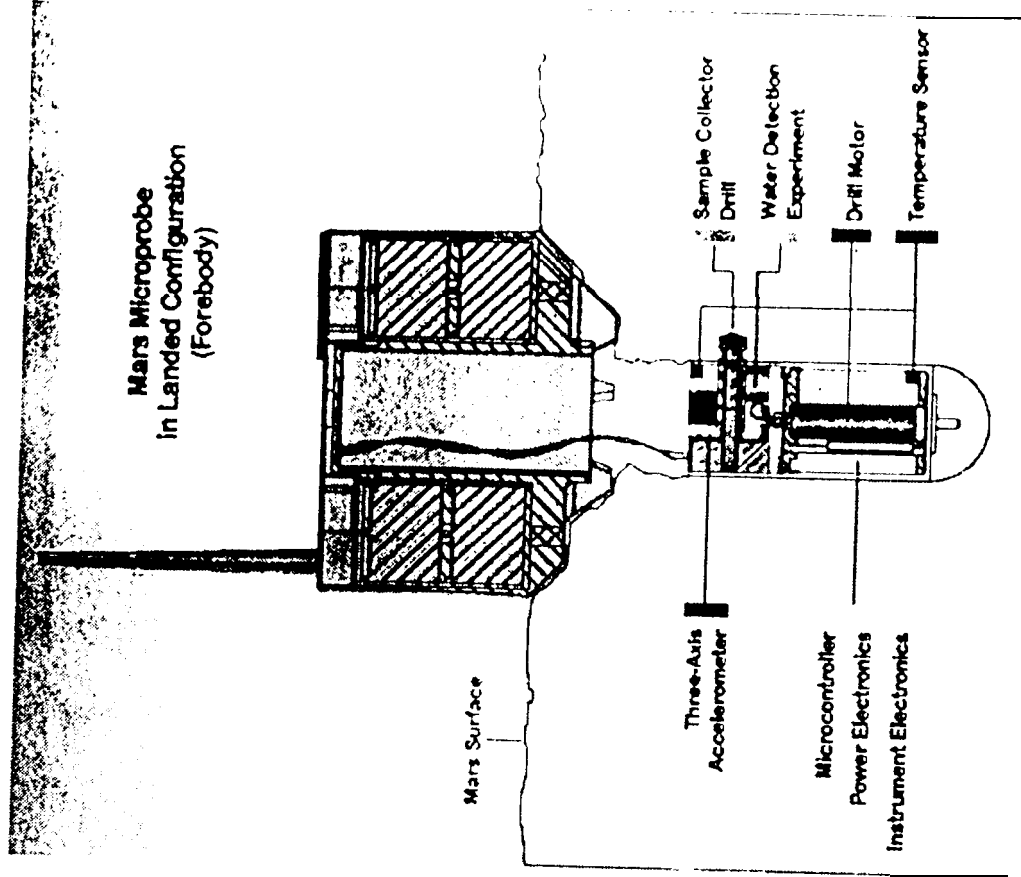




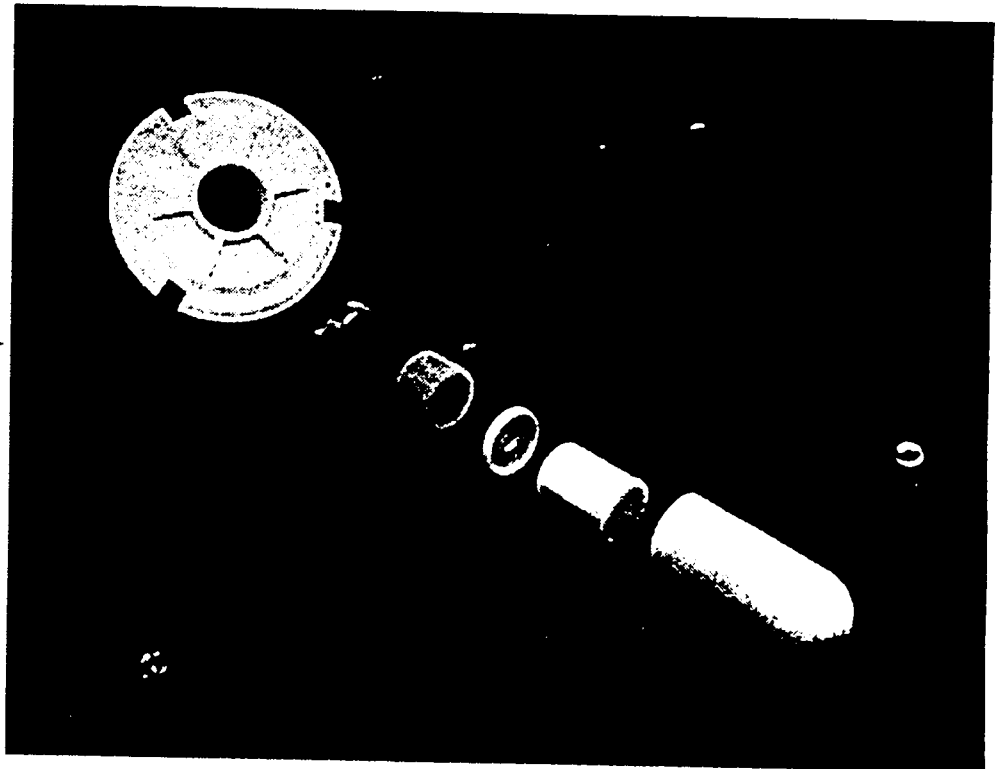
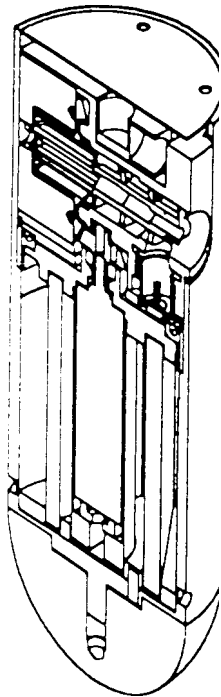
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- **SLS equipment and Concept Modeler are on-line and being used nearly 24 hours a day**
  - **Validating RP processes using the DS 2 Microprobe**
  - **Continuing to define/develop PA processes using RP models**
  - **Developing a JPL-led consortium to research and develop direct metal fabrication using the SLS and aluminum alloy powders**
    - Team members to-date include Boeing Defense & Space Group and JPL's Thermal & Propulsion Engineering Section (353)
  - **Teamed with JPL's Reengineering Teams (Develop New Products) to institutionalize the use of RP and allow access to all project and research activities.**
    - DBAT has embraced the RP process

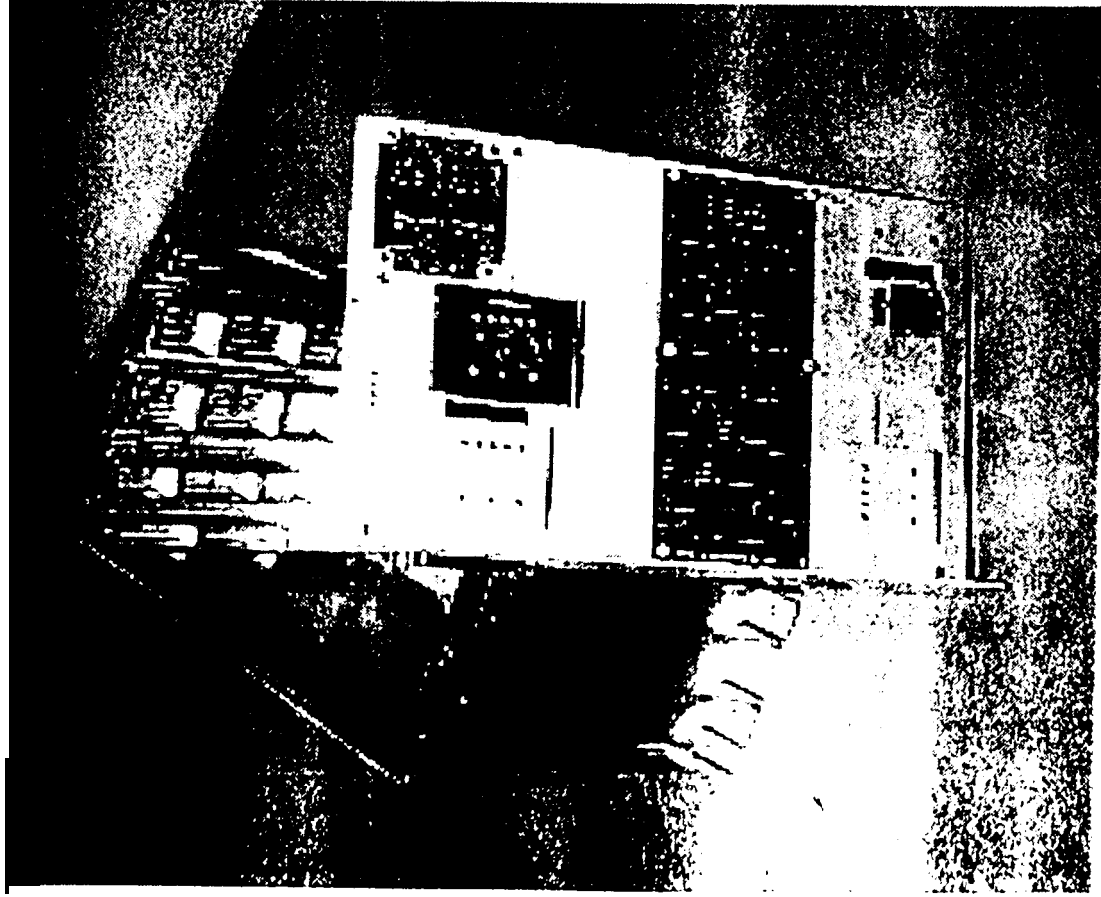


# Radio Prototyping Applications at JPL

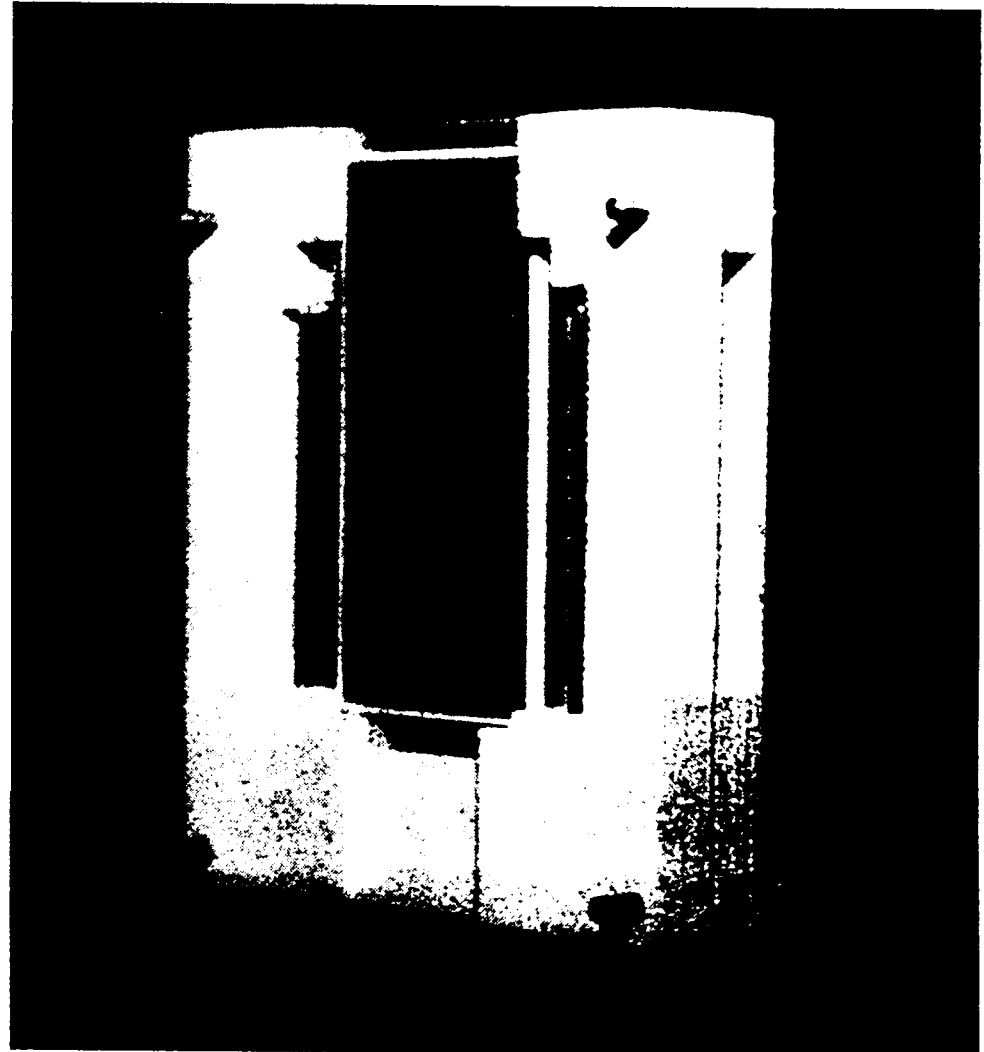


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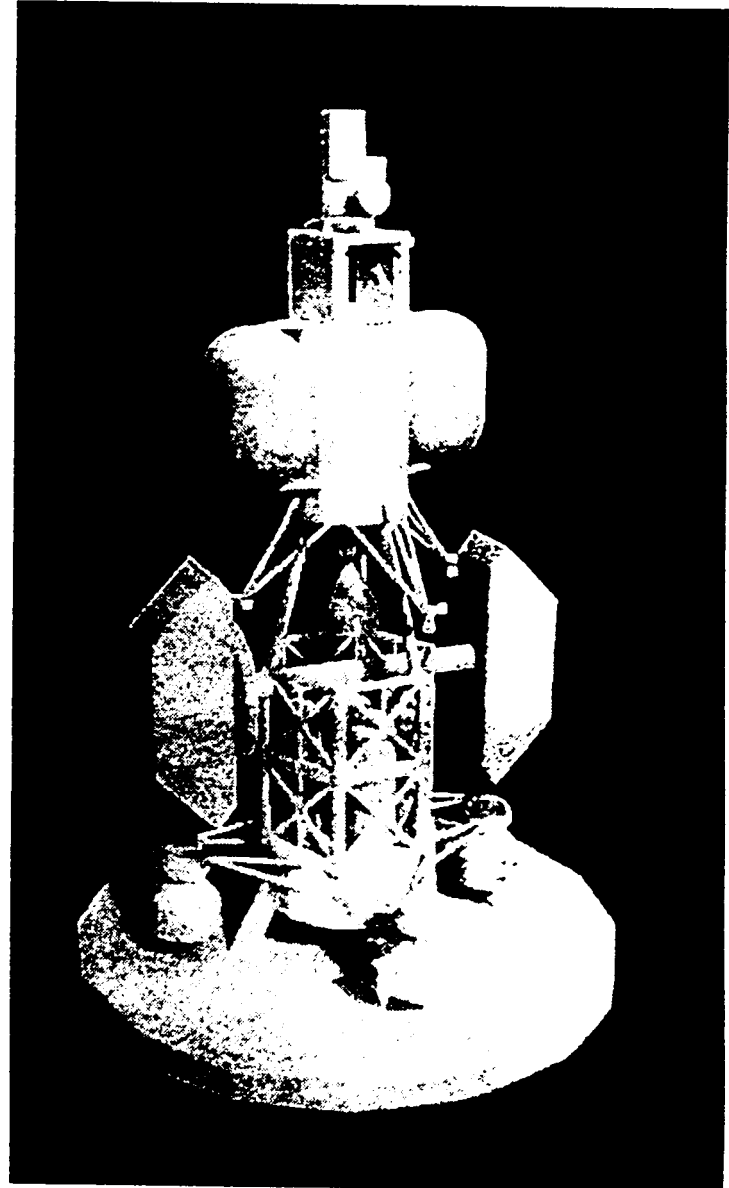


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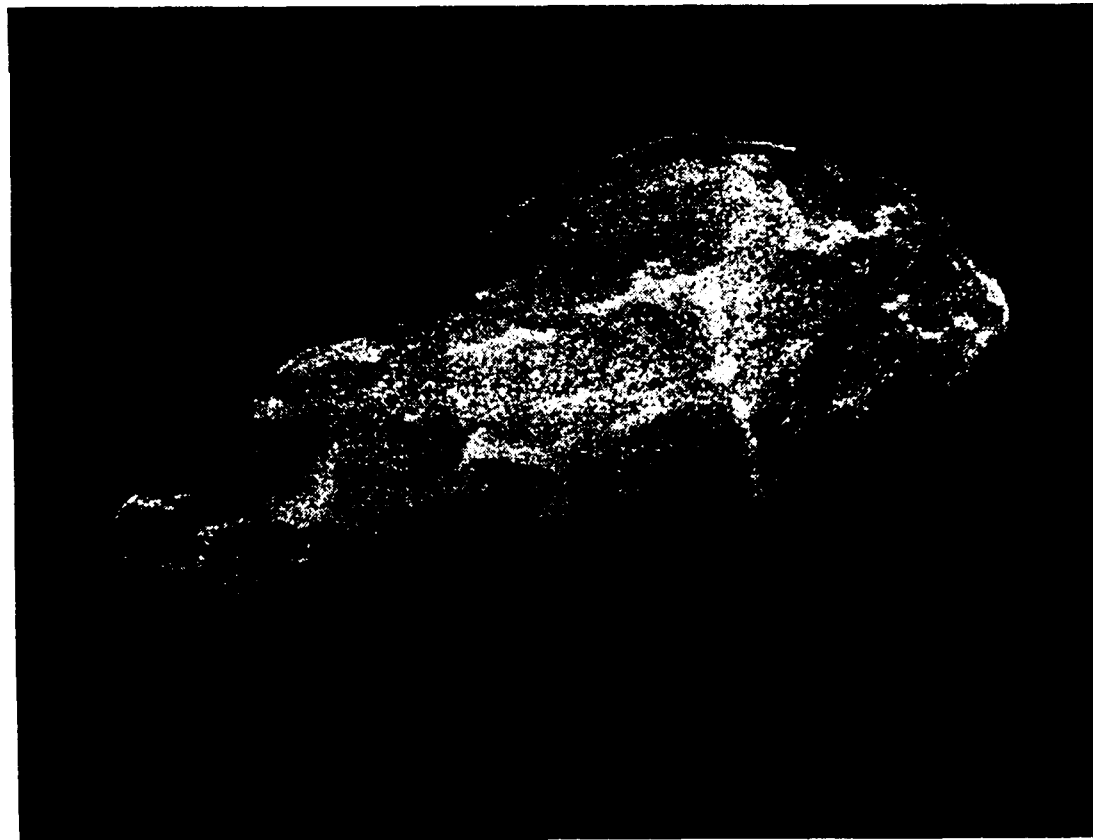


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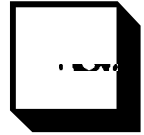
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Picture of the 3-D  
model of the asteroid  
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- **Continue the development and definition of processes which can be employed with RP models**
  - **Get the momentum going on the teaming/collaboration between JPL and industry for the direct metal RP developments**
  - **Continue to refine the integration of RP into DBAT**
  - **Support projects with the use of RP models to optimize their budget and schedule constraints**

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